Supporting Children with Down Syndrome

Developing Mathematical Understanding through the use of concrete apparatus and pictorial representations

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Research background

Julie Hughes

Adapting teaching to the learning profile of children

with Down syndrome

(Hughes J. Learning about number and maths. Down Syndrome News and Update. 2006;6(1);10-13.)

Typical Development

Age 2 to 3 - children begin to use number words to 'count' as they play, showing that are beginning to explore and understand counting.

Age 4 - children can answer questions such as 'How many?' and follow 'Give me..' instructions for numbers up to 10. They understand 'more' or 'less' for small numbers, but they do not yet understand the ordinal nature of the number system, i.e., that each 'next' number represents 'one more'.

Throughout primary school

- understand more about number concepts and the number system.
- By 8 and 9 years, most children know numbers up to 1000 and can count on or back in tens and hundreds.
- Within 0-100, they can count on or back in twos from any two digit number and order numbers to at least 1000, on a number line or number square.
- They know the 2, 5, and 10 times tables and understand the concept of division.
- They are beginning to understand the units of time (second, minutes, hours, day, week, month, and year) and know the relationships between them.
- They can measure, weigh, and compare lengths, masses and capacities using standard units. They are also beginning to understand money.

This level of achievement would certainly provide the knowledge and skills necessary of most everyday life and work situations requiring number and/or maths skills.

What can influence progress?

- the quality and extent of their learning opportunities at home and at preschool. Parents should be encouraged to draw their child's attention to the uses of number in everyday life and engage him/her in games that teach counting and quantity.
- Practice (e.g count word sequence, bonds, tables) to help free up working memory
- Use of alternative recording strategies for children who find writing numerals difficult
- Use of visual supports wherever possible

Developmental profile of pupils with DS

- Delayed motor skills which makes manipulating small items, drawing and writing difficult
- Delays in speech and language development leading to conceptual difficulties
- Auditory processing and working memory difficulties making learning from listening very difficult

- Strengths in social understanding and enjoyment of learning from social interaction with peers and adults
- Strengths in visual processing and visual memory, **learning from seeing is an important and effective strategy**
- Strengths in using gesture, **showing understanding by pointing to or choosing an answer**

(Handout - General principles for teaching numeracy effectively to pupils with DS)

Summary

Consistently good teaching strategies throughout the school years are needed before the achievements of individuals with Down syndrome reflect their true potential for the development of maths and number skills.

Pupils need a high standard of teaching, using a variety of techniques and approaches, with daily practice and everyday relevance.

Social inclusion within the school and the community will help children apply their maths and number skills to everyday life.

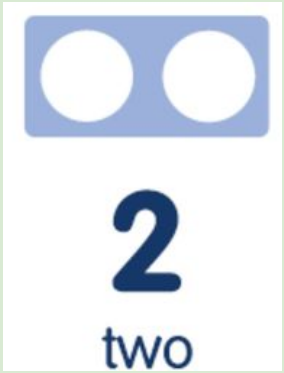
Increasing numbers of children with Down syndrome are improving their skills with access to better teaching at school, higher expectations within the family and at school, and greater opportunities to use their skills independently in the community.

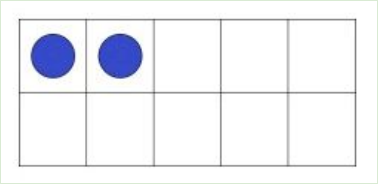
Early principles

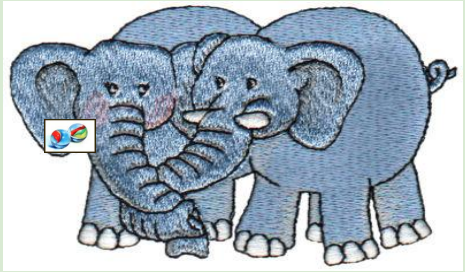
Relative Value of Number

How many representations of the value two can you think of?

Relative Value of Number







Jack and Jill

- Every other word represents a number, in order.

- Starting at Jack = 1

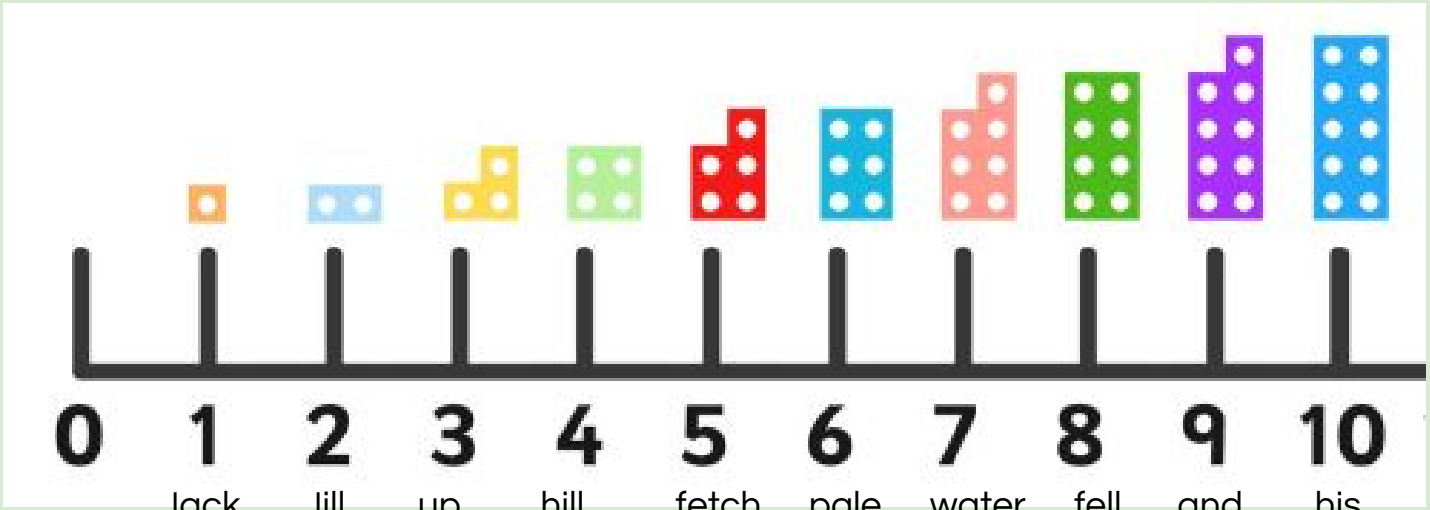
Jack and Jill

Jack and Jill

Jack Jill up hill fetch pale water fell and his

Jack and Jill

Jack and Jill



- Jottings
- Keep associating numbers with visual aids
- Concrete apparatus

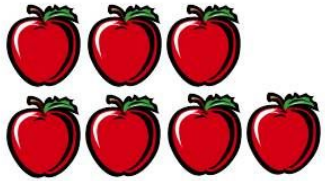
CPA

CPA Approach

CPA Approach	
Stage	**Characteristics**
Concrete	Refers to the use of manipulatives, measuring tools or objects that the student handles.
Pictorial	Refers to the use of drawings, diagrams, charts or graphs that the student draws
Abstract	Refers to abstract representations such as numbers and letters that the student writes

Example:
Tom had 3 apples. His mother gave him 4 more apples. How many apples did he have altogether?

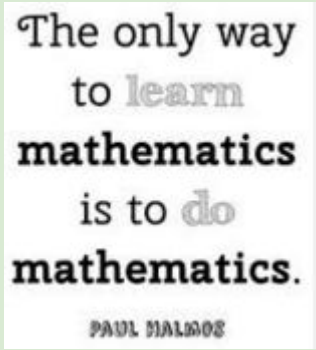
Concrete
Give apples and count



Pictorial
Draw apples and count

3 + 4 = 7

Abstract
Write the number statement



Fundamentals of ‘Shanghai’ and ‘Singapore’ Maths

- 5 Basic Learning Theorists

- **Piaget**- ample processing time
- **Dienes** – Informal exploration before structured learning
- **Vygotsky** – collaborative learning structures
- **Skemp** – Relational understanding
- **Bruner** – CPA approach

Every Child Succeeds
“An excellent vehicle for the development and improvement of a person’s intellectual competence.”
Focus on thinking and problem solving
Structure and Materials

+	0	1	2	3	4	5	6	7	8	9	10
0	0 + 0	0 + 1	0 + 2	0 + 3	0 + 4	0 + 5	0 + 6	0 + 7	0 + 8	0 + 9	0 + 10
1	1 + 0	1 + 1	1 + 2	1 + 3	1 + 4	1 + 5	1 + 6	1 + 7	1 + 8	1 + 9	1 + 10
2	2 + 0	2 + 1	2 + 2	2 + 3	2 + 4	2 + 5	2 + 6	2 + 7	2 + 8	2 + 9	2 + 10
3	3 + 0	3 + 1	3 + 2	3 + 3	3 + 4	3 + 5	3 + 6	3 + 7	3 + 8	3 + 9	3 + 10
4	4 + 0	4 + 1	4 + 2	4 + 3	4 + 4	4 + 5	4 + 6	4 + 7	4 + 8	4 + 9	4 + 10
5	5 + 0	5 + 1	5 + 2	5 + 3	5 + 4	5 + 5	5 + 6	5 + 7	5 + 8	5 + 9	5 + 10
6	6 + 0	6 + 1	6 + 2	6 + 3	6 + 4	6 + 5	6 + 6	6 + 7	6 + 8	6 + 9	6 + 10
7	7 + 0	7 + 1	7 + 2	7 + 3	7 + 4	7 + 5	7 + 6	7 + 7	7 + 8	7 + 9	7 + 10
8	8 + 0	8 + 1	8 + 2	8 + 3	8 + 4	8 + 5	8 + 6	8 + 7	8 + 8	8 + 9	8 + 10
9	9 + 0	9 + 1	9 + 2	9 + 3	9 + 4	9 + 5	9 + 6	9 + 7	9 + 8	9 + 9	9 + 10
10	10 + 0	10 + 1	10 + 2	10 + 3	10 + 4	10 + 5	10 + 6	10 + 7	10 + 8	10 + 9	10 + 10

Lucy . Nov 16.

Adding 1 | Bonds to 10 | Adding 10 | Bridging/ compensating

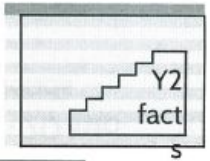
Adding 2 | Adding 0 | Doubles | Near doubles

+	0	1	2	3	4	5	6	7	8	9	10
0	K	K	K	K	K	K	K	K	K	K	K
1	K	K	K	K	C	C	C	C	C	K	K
2	K	K	K	K	K	C	K	K	K	C	K
3	K	K	K	K	K			C	C		K
4	K	K	K	C	K	K/5	C	C			K
5	K	K	K	C	C	K					K
6	K	K	K	C	C						K
7	K	K	K	K							K
8	K	K	K	C							K
9	K	K	C	C							K
10	K	K	K	K	K	K	K	K	K	K	K

Lucy 17.2.17

Adding 1 | Bonds to 10 | Adding 10 | Bridging/ compensating

Adding 2 | Adding 0 | Doubles | Near doubles



+	0	1	2	3	4	5	6	7	8	9	10
0	0 K		2 K							9 K	
1	1 K							7 K			
2	2 K								10 K	11 S	
3	3 K			6 K						12 K	13 K
4				7 C			10 K		12 S		
5				8 C	9 S	10 K	12 K	12 S			
6			8 K	9 C		11 S				15 C	
7			9 K					14 C	15 S		
8	8 K		10 K				14 C		16 K	17 S	
9		10 K		12 K							
10	10 K										

8+4. It's like 3 lots of 4.

8+6

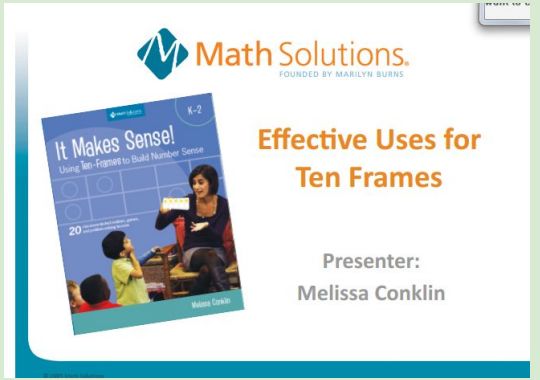
8+8-2

Progression

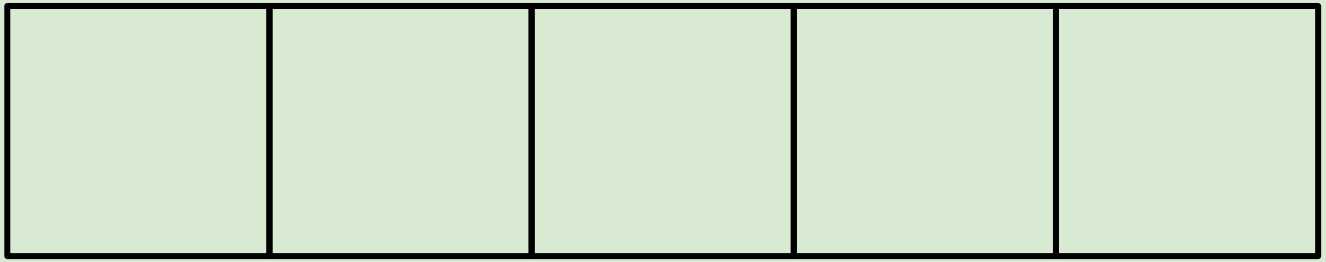
1. Adding 1 (e.g. 7 + 1 and 1 + 7)
2. Doubles and near double of numbers to 5 (e.g. 3 + 3, 4 + 5, 5 + 4)
3. Adding 2 (e.g. 4 + 2 and 2 + 4)
4. Number bonds to 10 (e.g. 8 + 2 and 2 + 8)
5. Adding 0 to a number (e.g. 3 + 0 and 0 + 3)
6. Adding 10 to a number (e.g. 5 + 10 and 10 + 5)
7. The ones without a family 5 + 3, 3 + 5, 6 + 3, 3 + 6 (these pairs of facts are the only ones which don't fit in any of the other families, though the last two can be related to counting in 3s)
8. Doubles of numbers to 10 (e.g. 7 + 7)
9. Near doubles (e.g. 5 + 6 and 6 + 5)
10. Bridging (e.g. 8 + 4 and 4 + 8)
11. Compensating.

Ten Frames

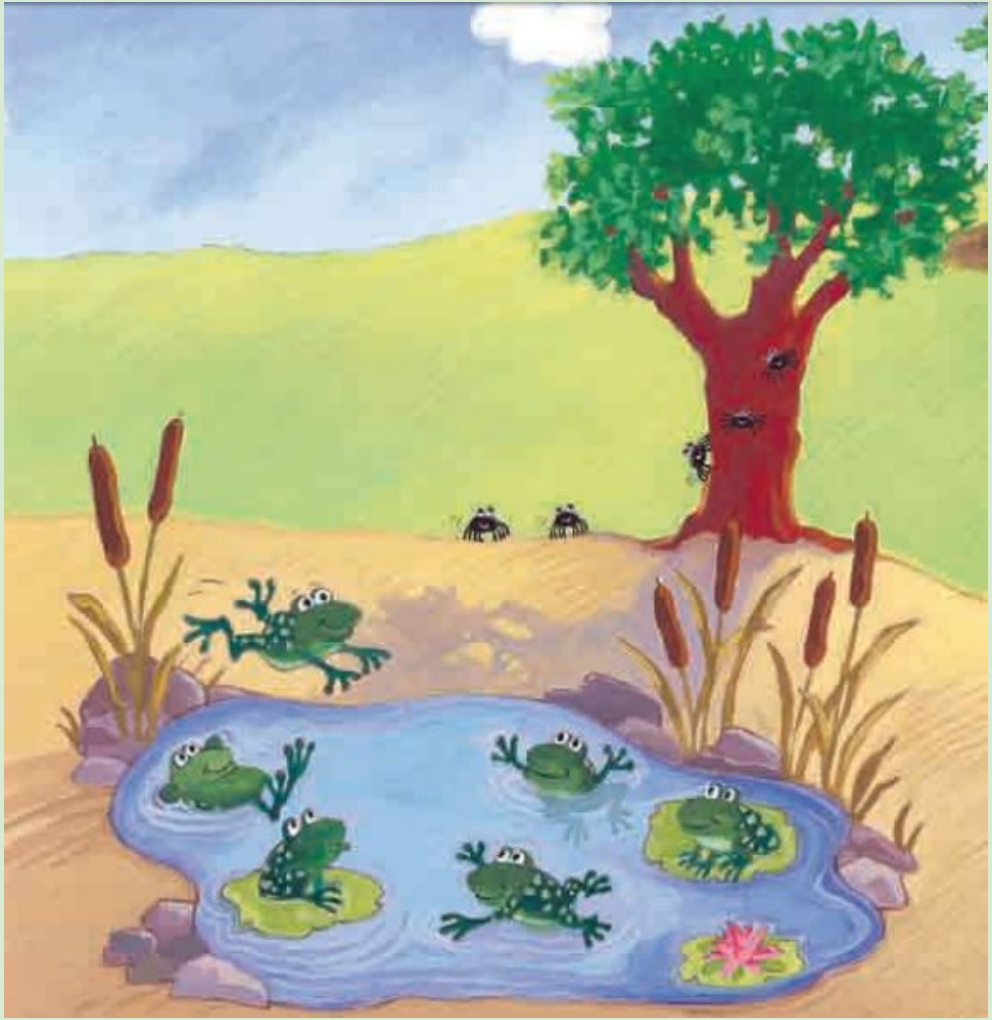

Dot Card and Ten Frame Activities


Math Solutions
FOUNDED BY MARILYN BURNS
It Makes Sense!
Using Ten-Frames to Build Number Sense
K–2
Effective Uses for Ten Frames
Presenter:
Melissa Conklin

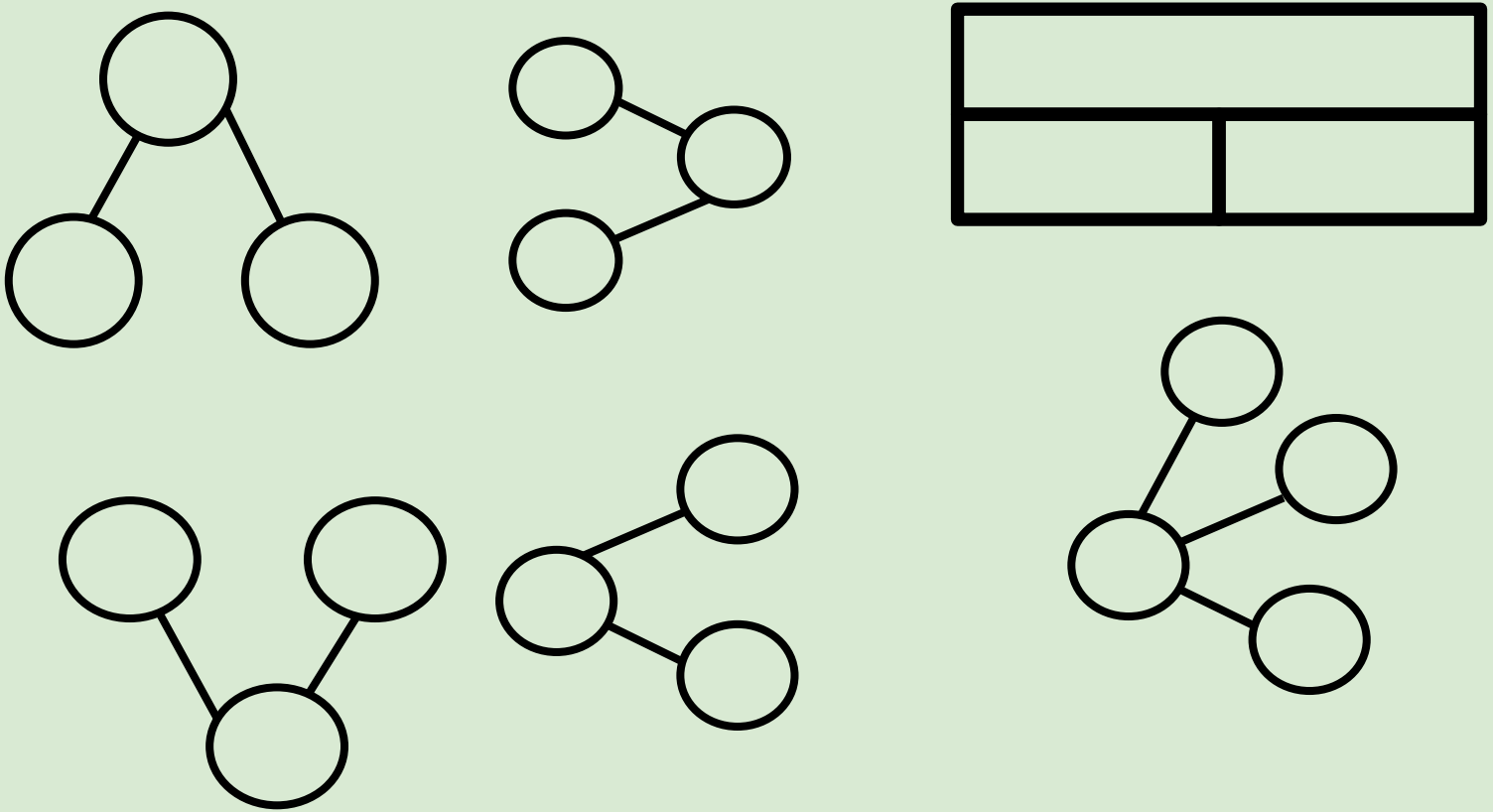
Begin with 5 frames...



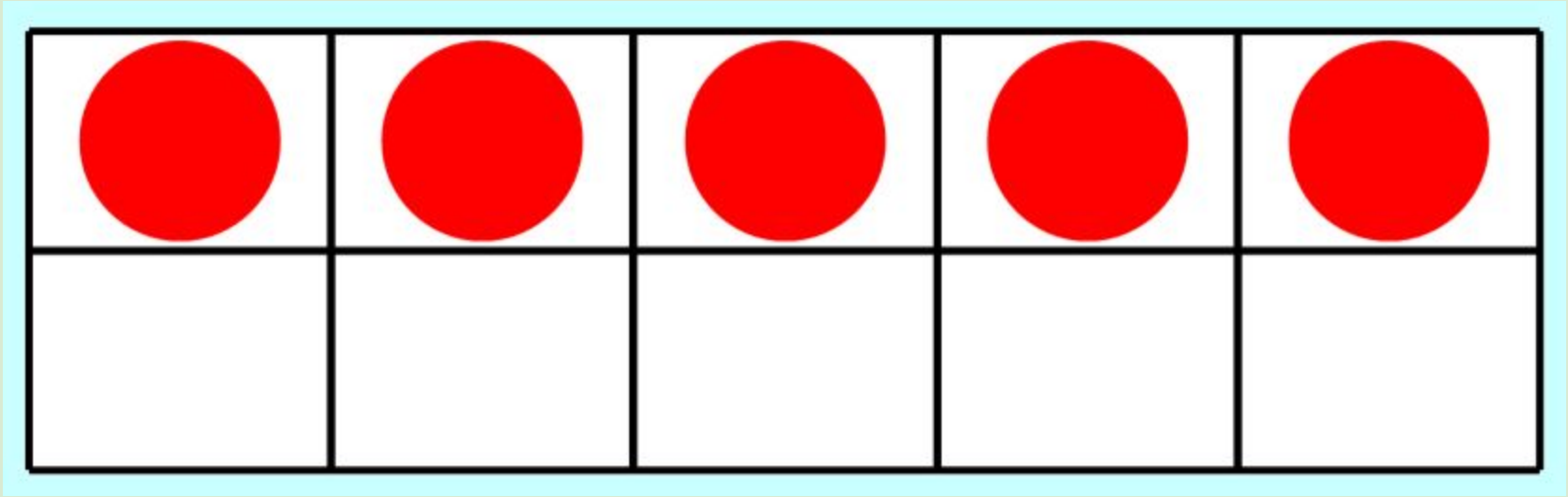
Making five on a five frame

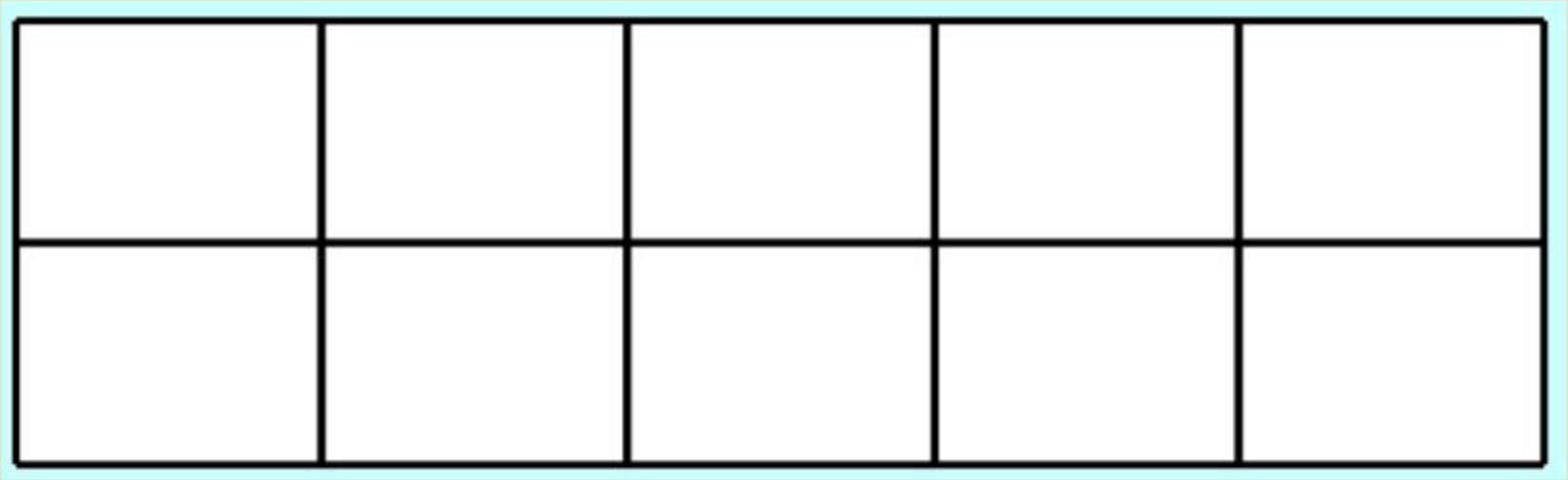


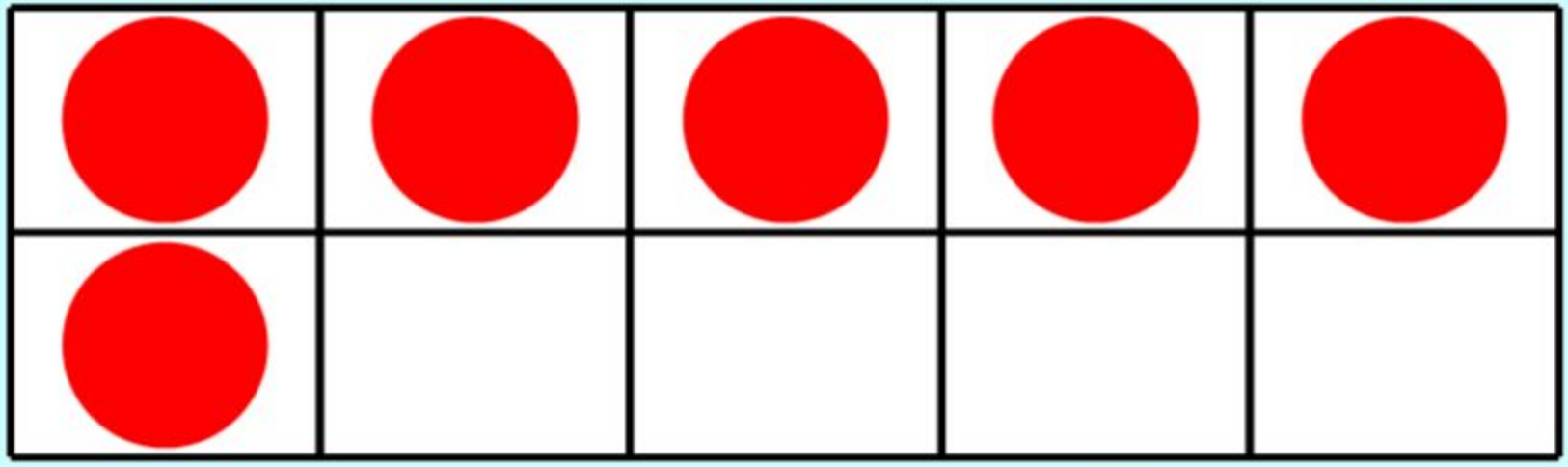
Part-Part-Whole Model

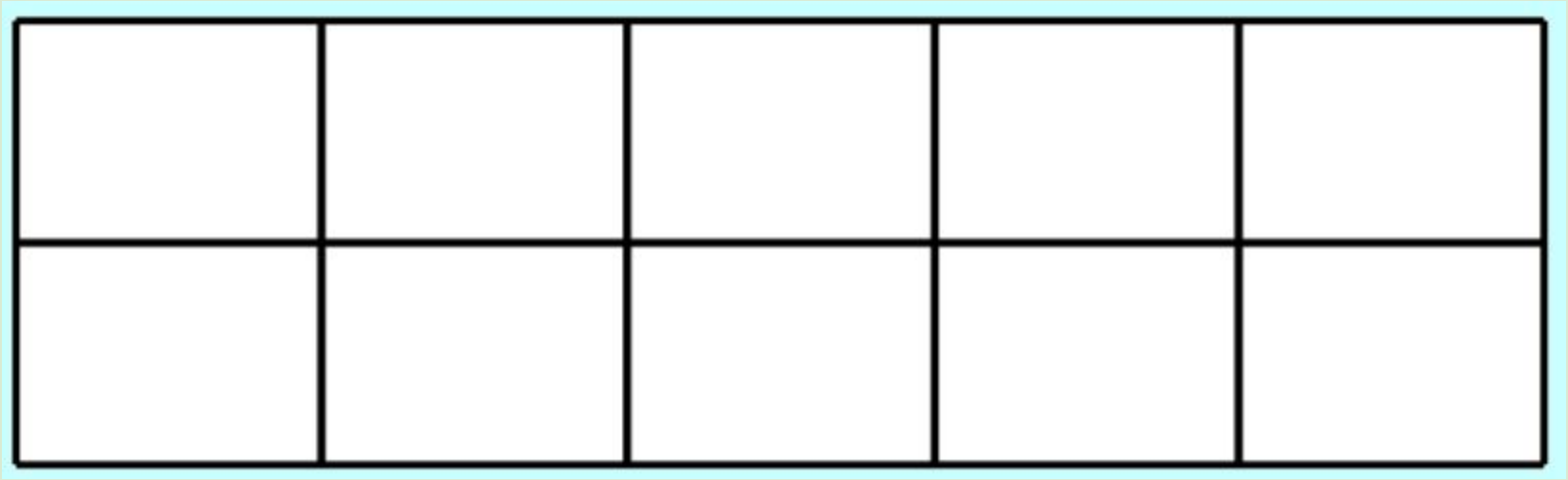


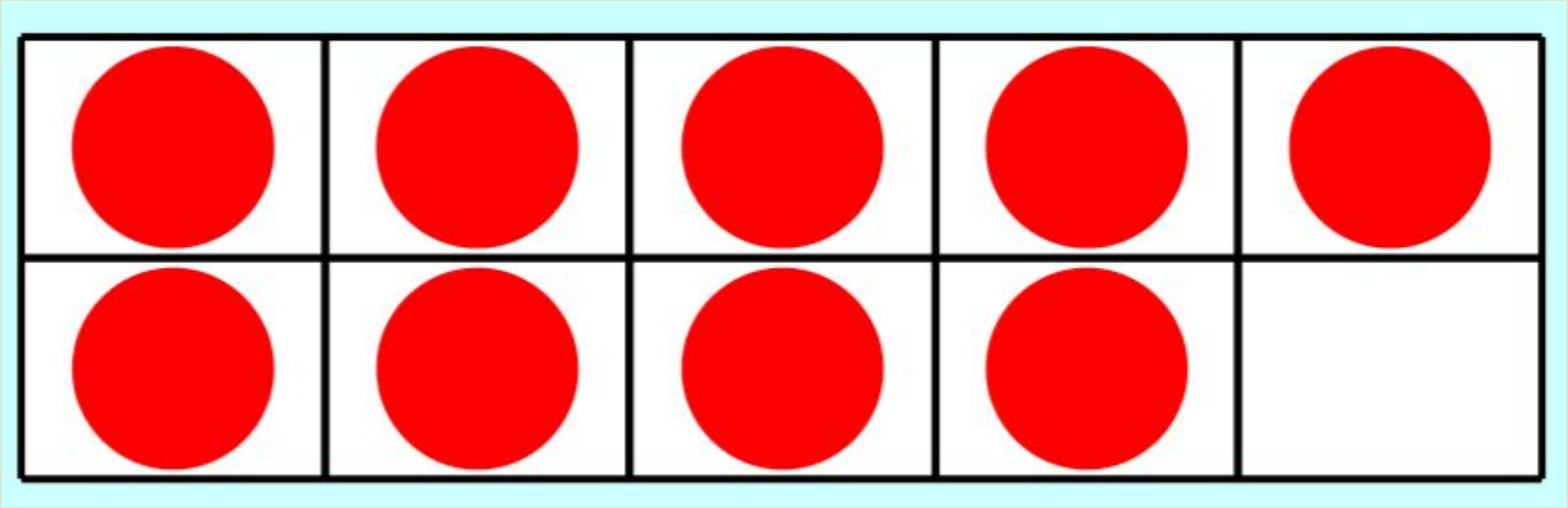
10 frame flash



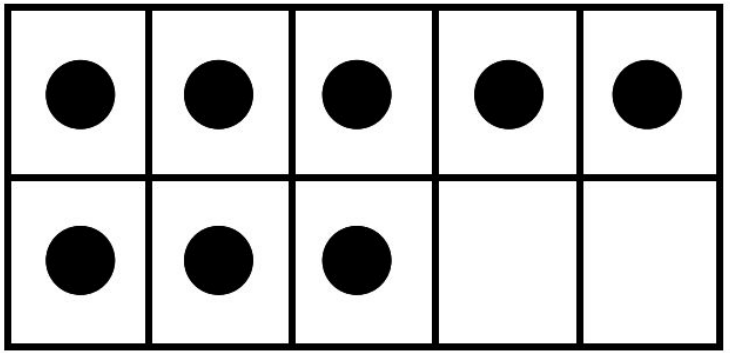








Snap!
Memory game!



8

What's my card?

Partitioning numbers under 10 through a context

Spikey has some jelly beans.

Curley has some jelly beans.

Together they have seven jelly beans.

How many could they each have?

Maths No Problem Questions...

a) 2 + 8 + 4 = _ + _

= _

b) 3 + 9 + 1 = _ + _

= _

Maths No Problem Questions...

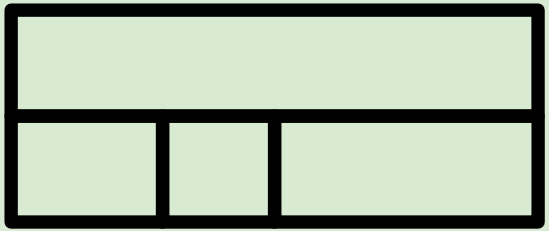
a) 6 + 7 + 4 =

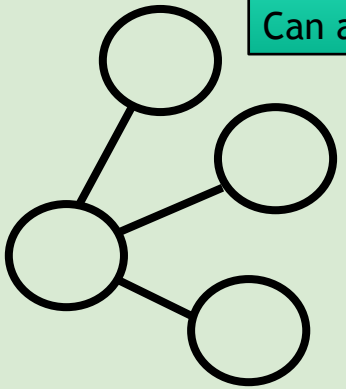
b) 9 + 0 + 4 =

c) 8 + 5 + 9 =

d) 7 + 9 + 6 =

Where could we take this?





What are the smallest and largest totals in the bag using 3 of the shapes 1-10?

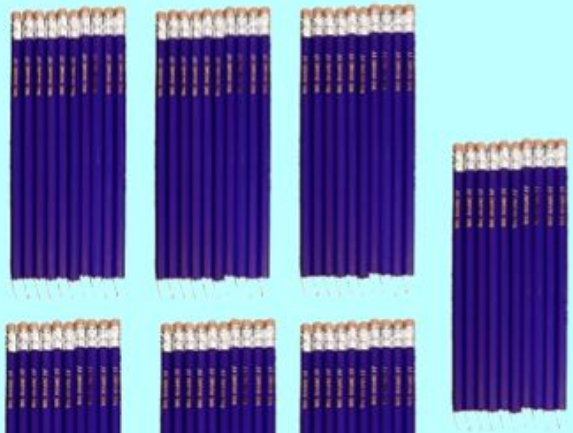
Can all totals in between be created?

I have 3 shapes in the feely bag – the total is 15 – what combinations could be in the bag?

How do you know you have got them all?

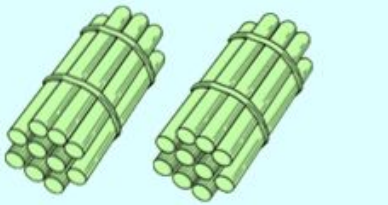
Show them one of the shapes – what could the others numbers be?

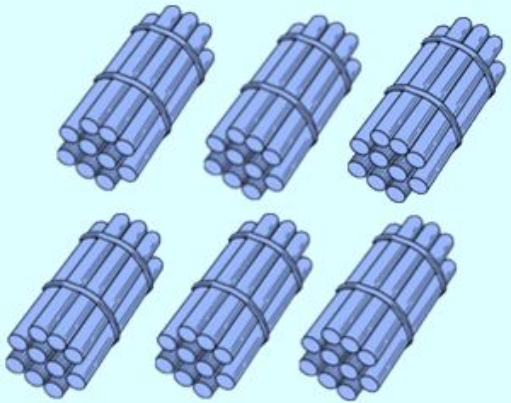
Tell the story and ask a question.

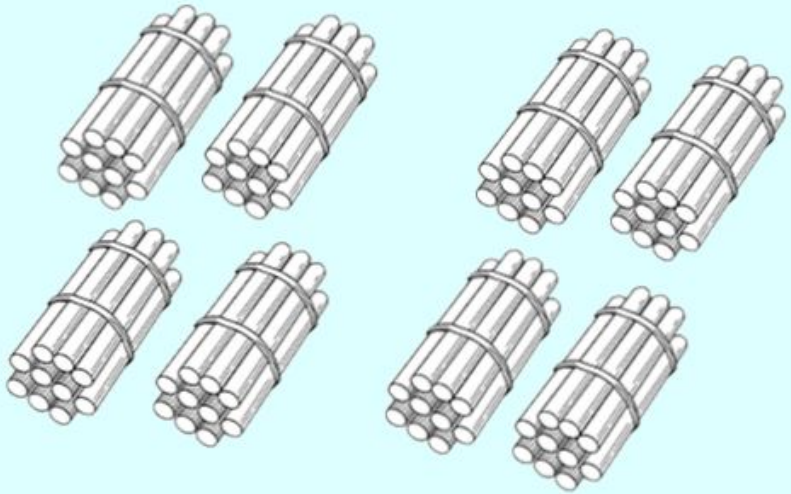


There are ____ and _____ and ____.

Tell the story and ask a question.



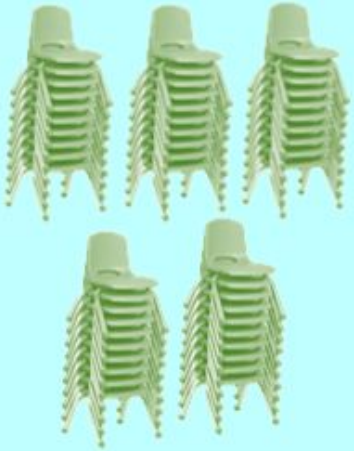


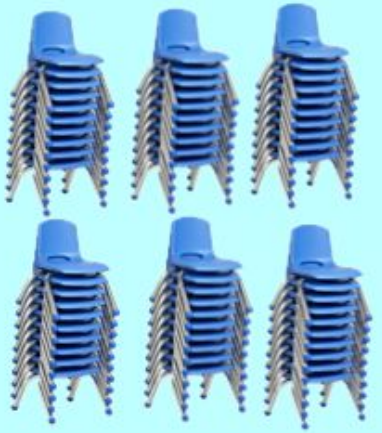


There are ____ and _____ and ___

Tell the story and ask a question.

There are ____ and _____ and ____.



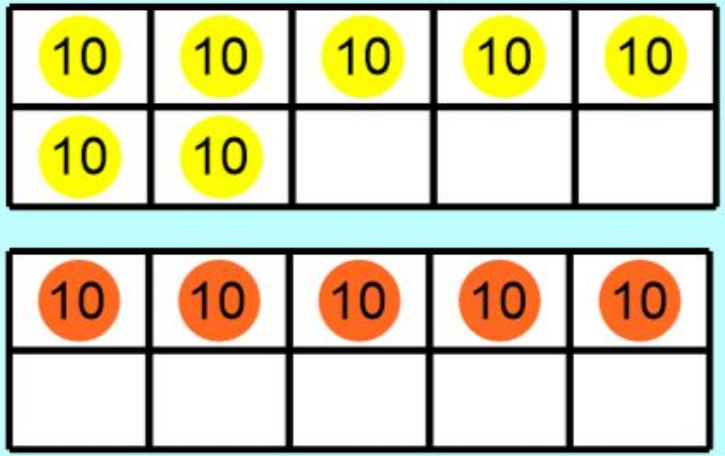


$$30 + 80 + 70 =$$

$$20 + 90 + 80 =$$

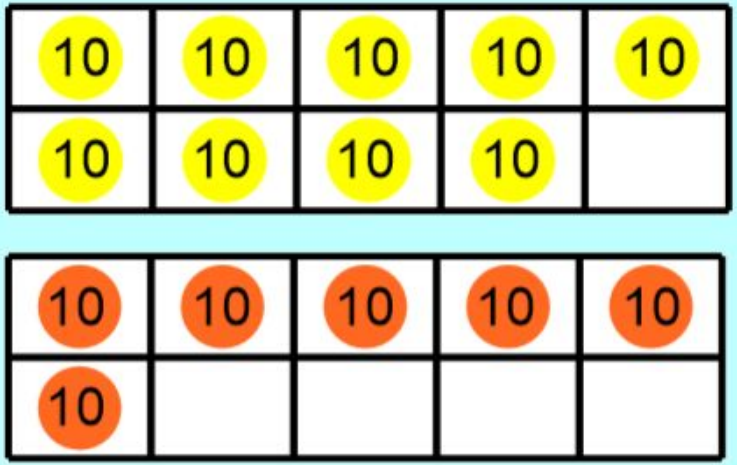
How can we change this to make an addition with 3 multiples of 10, two of which equal 100?

70 + 50



How can we change this to make an addition with 3 multiples of 10, two of which equal 100?

90 + 60



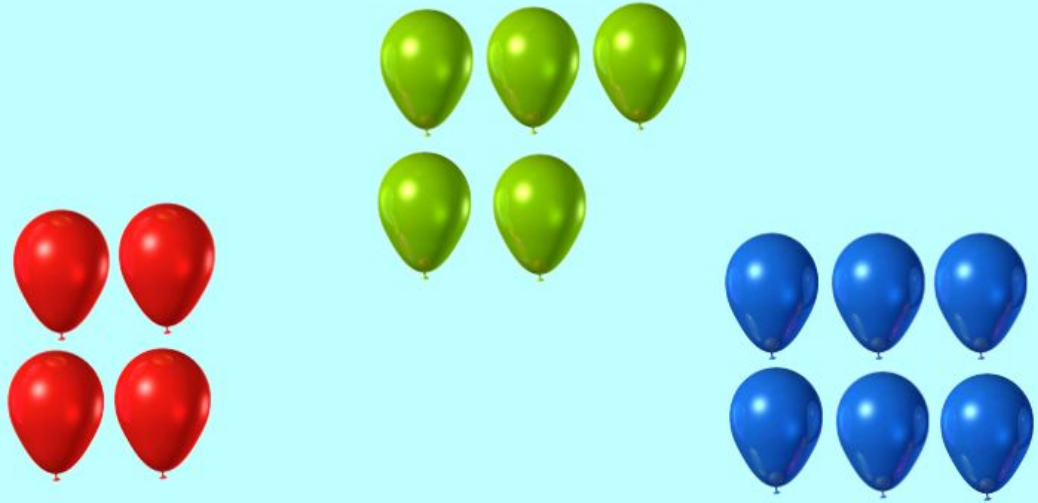
Addition

Augmentation and Aggregation

Aggregation

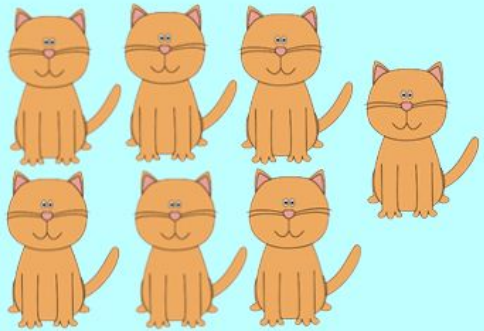
Tell the story and ask a question.

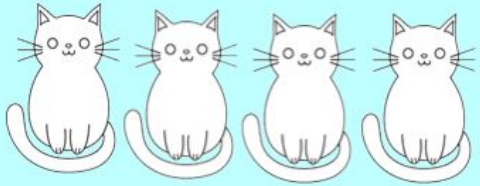
There are ____ and _____ and ____.



Aggregation

Tell the story and ask a question.

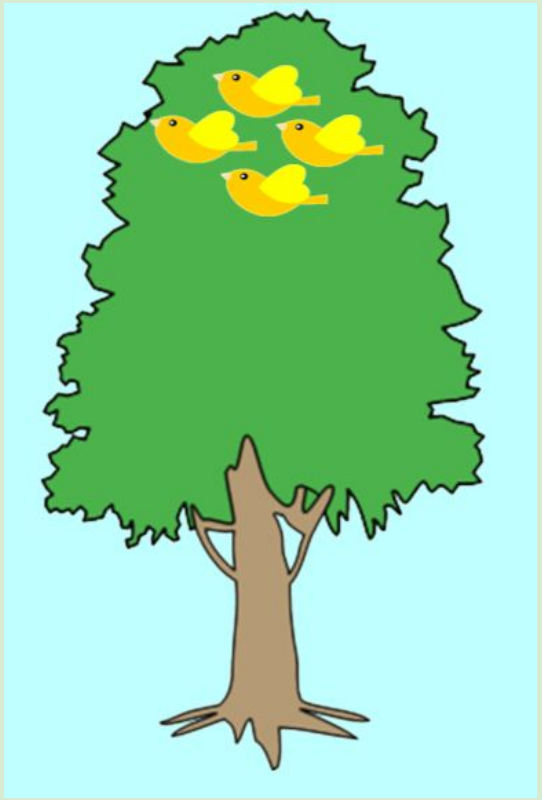


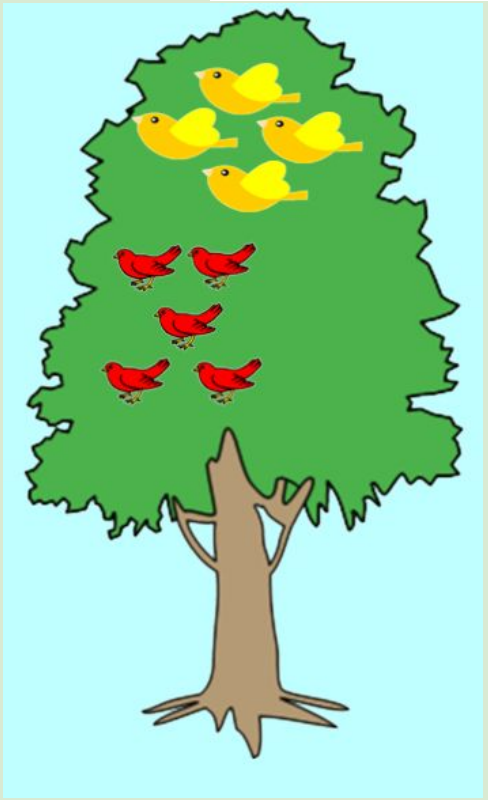


There are ____ and _____ and ____.

Augmentation

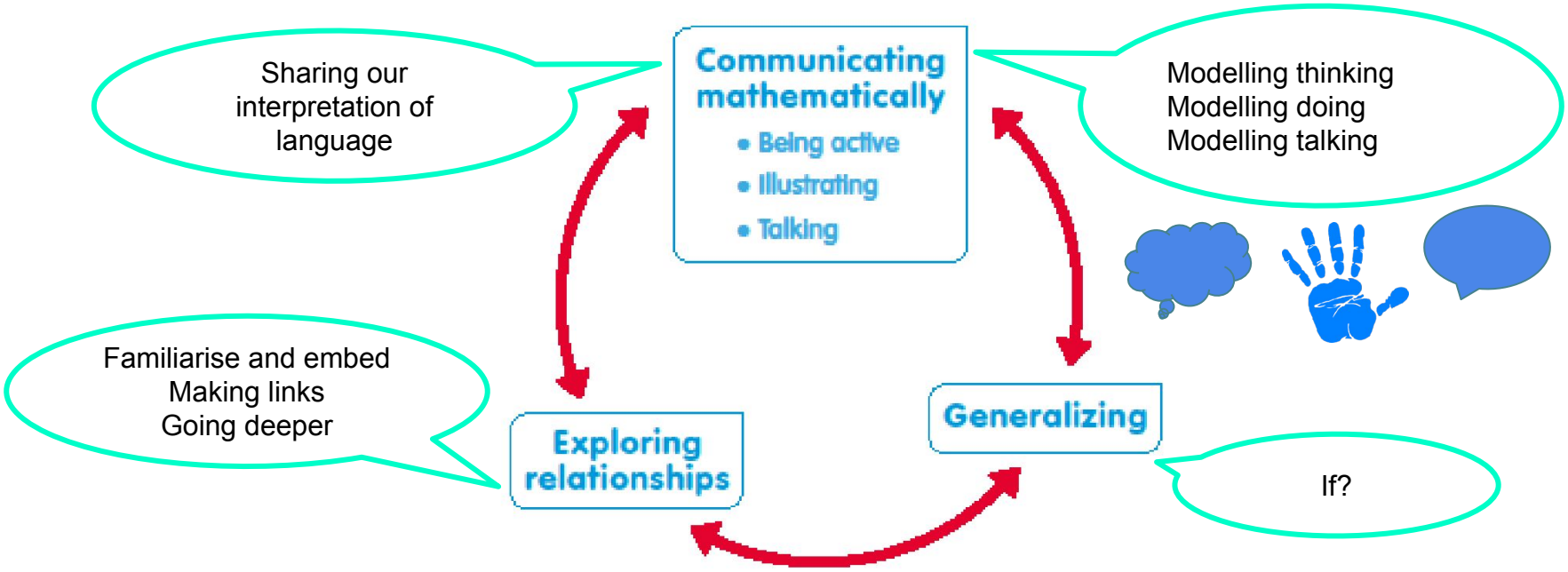
First _____ then_____ then_____.





Number, Pattern and Calculating

Numicon



Active thinking – In every lesson.

“Thinking is communicating with yourself.”

Communicating mathematically

- Being active
- Illustrating
- Talking

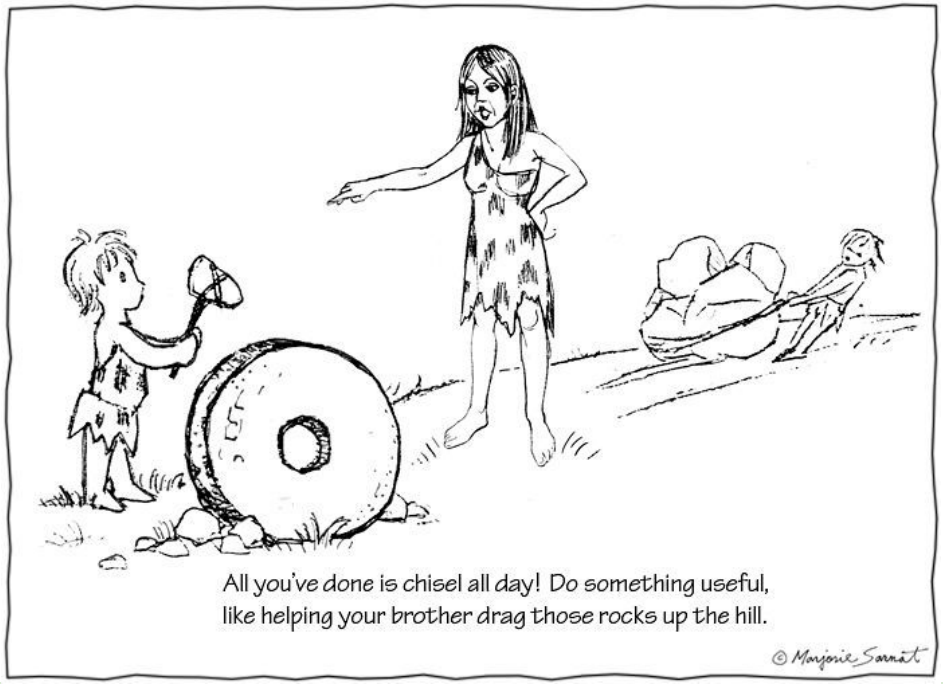
The Language of Maths

1 2 3 4 **5** 6 7 8 9 10

Communicating mathematically

- Being active
- Illustrating
- Talking

The Language of Maths



Where to start?

- Exploration and play
- Familiarisation

Familiarity with apparatus enables pupils to choose the resources they need to support them in their thinking and communicating about mathematical ideas.

Communicating mathematically

- Being active
- Illustrating
- Talking

1. Work together to find different ways to sort the shapes into sets
2. Describe the sets you have made
3. Record some of your ideas as they develop

Communicating mathematically

- Being active
- Illustrating
- Talking

Embedded into indoor play activities...

Communicating mathematically

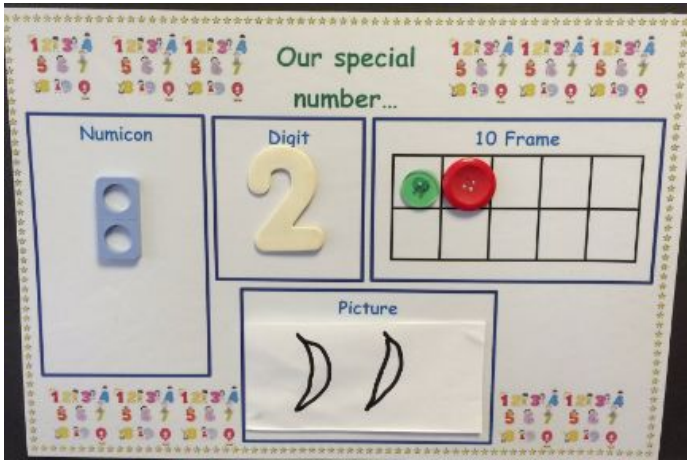
- Being active
- Illustrating
- Talking

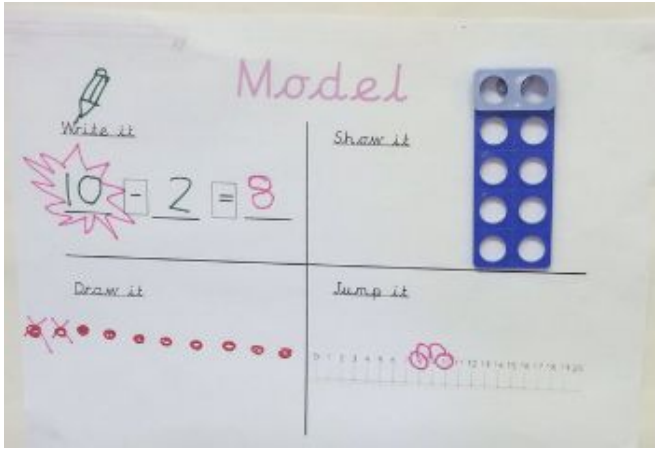
...into cooking...

Communicating mathematically

- Being active
- Illustrating
- Talking

...take it outside...





Communicating mathematically

- Being active
- Illustrating
- Talking

...and embed into routines.

It is half...

It is double...

It is in between … and...

It is two more than...

It is nearly...

If we put it with the...shape, together they equal...

It is after...

It is one less than...

It is more than...

Exploring relationships

Pick a shape and a bubble then describe to your partner.

Bar Modelling

Bar Modelling

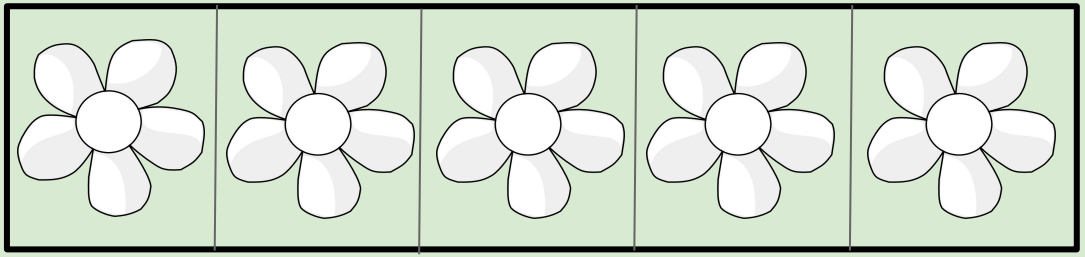
It is a problem-solving heuristic that requires children to reflect on how they could accurately represent the information presented in problems, first in terms of a drawing and then as a series of arithmetic equations.


C7P

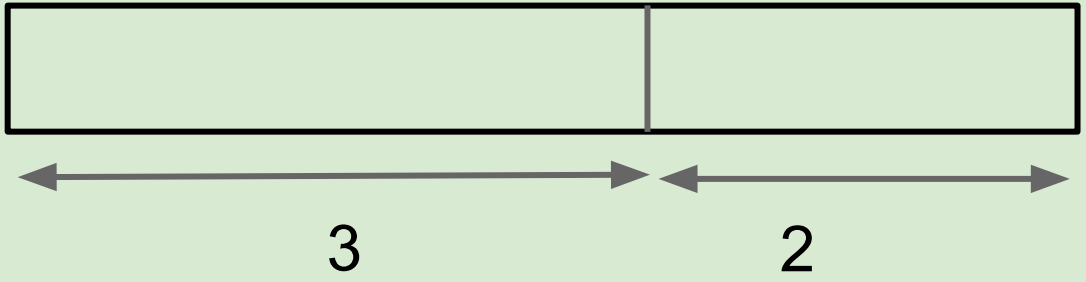
Bruner's Theory of Representation

Enactive representation

Iconic representation

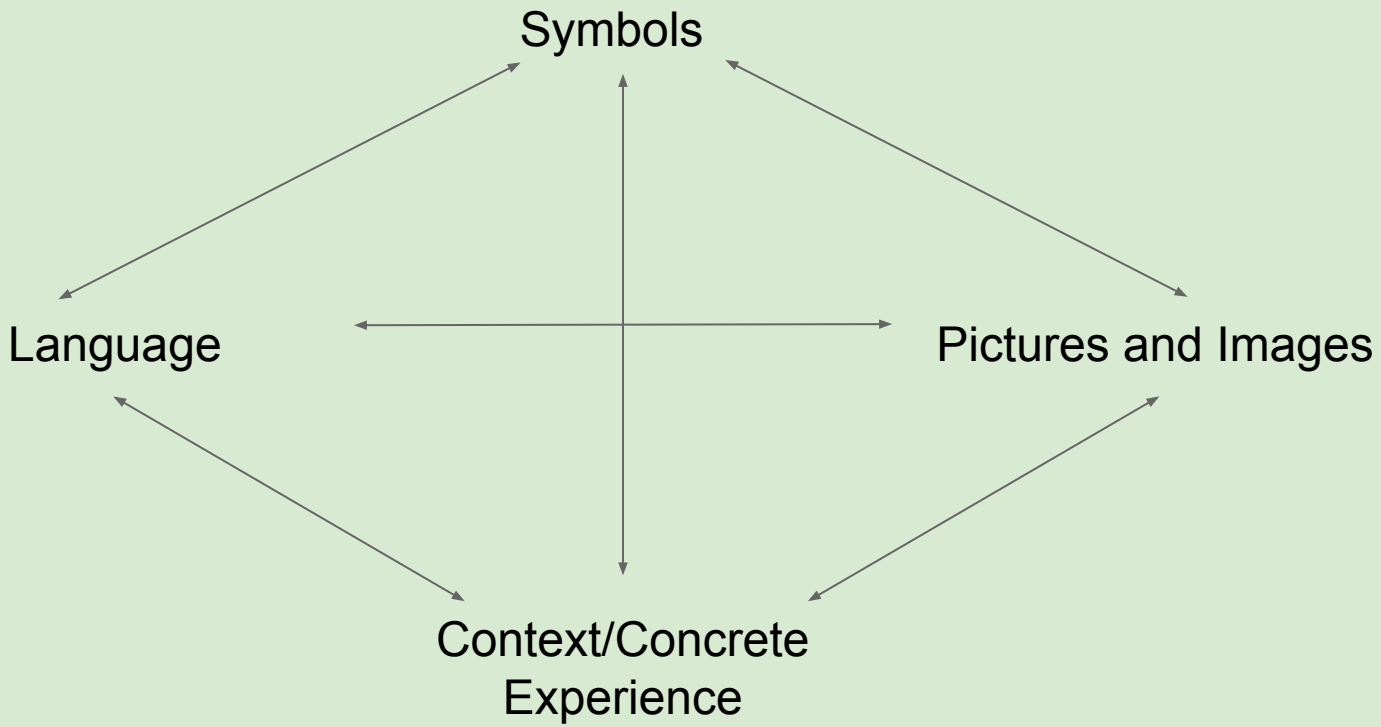


Symbolic representation



The Connective Model for Learning Maths

(Haylock and Cockburn 2008)



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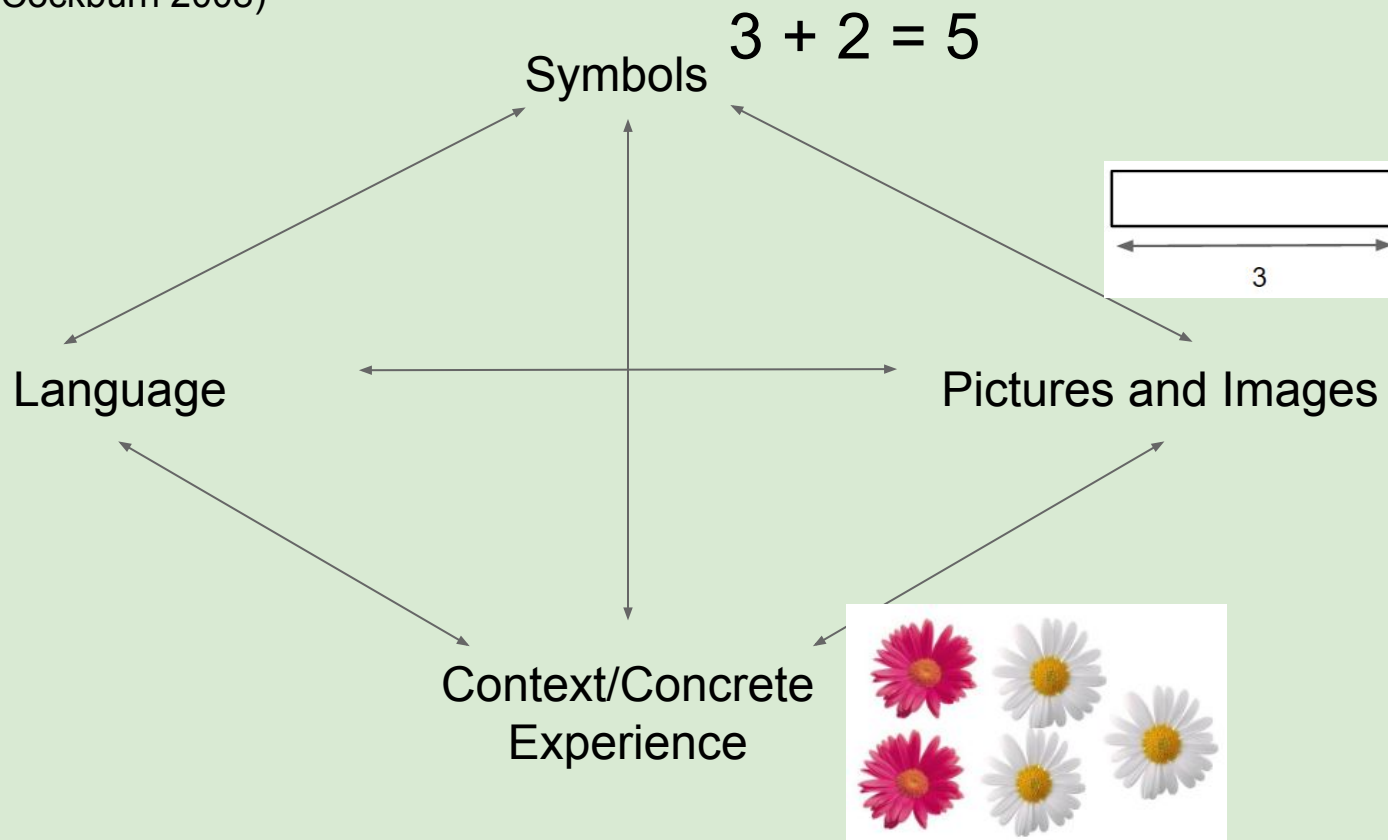


A Bar Model

Helps children to:

- Visualise the problem
- Identify the unknown quantity
- Understand what operation to perform
- See relationships and structures
- View problems from an algebraic perspective

Why Rectangles?

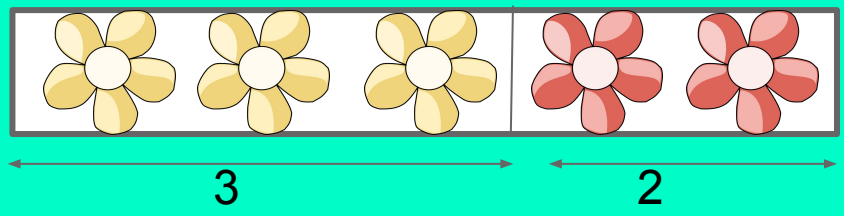
They are easy to:

- **Draw**

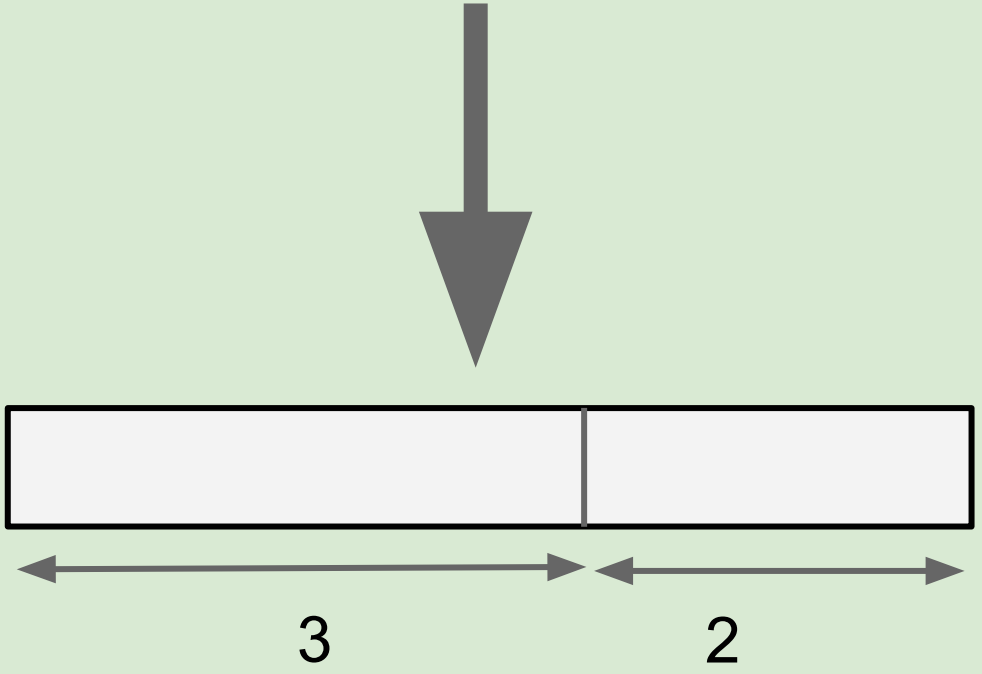
- **Divide**

- **Represent larger numbers**

- **Display Proportional Relationships**



Step by step approach



Step 1 - Counting Objects

Step 2 - Lining up objects in rows

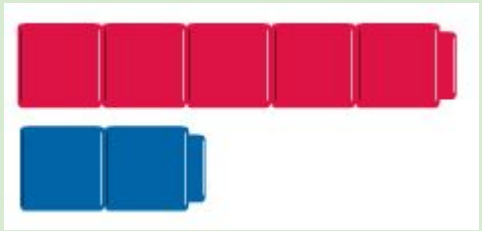


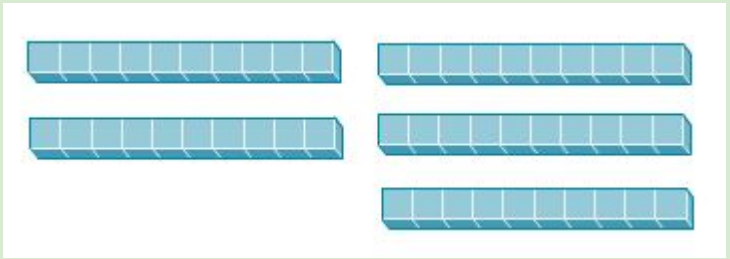




Step 2 - lining up objects

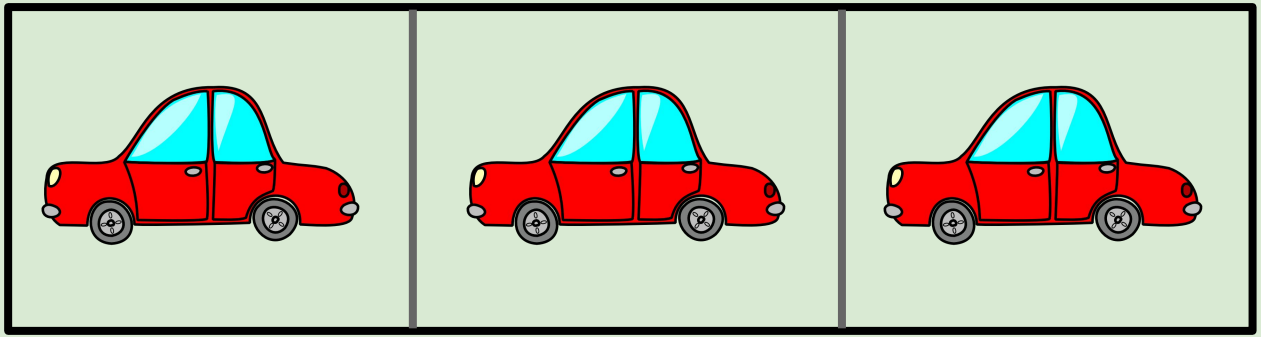
Organisation helps with mathematical language and reveals structure of number or calculation.



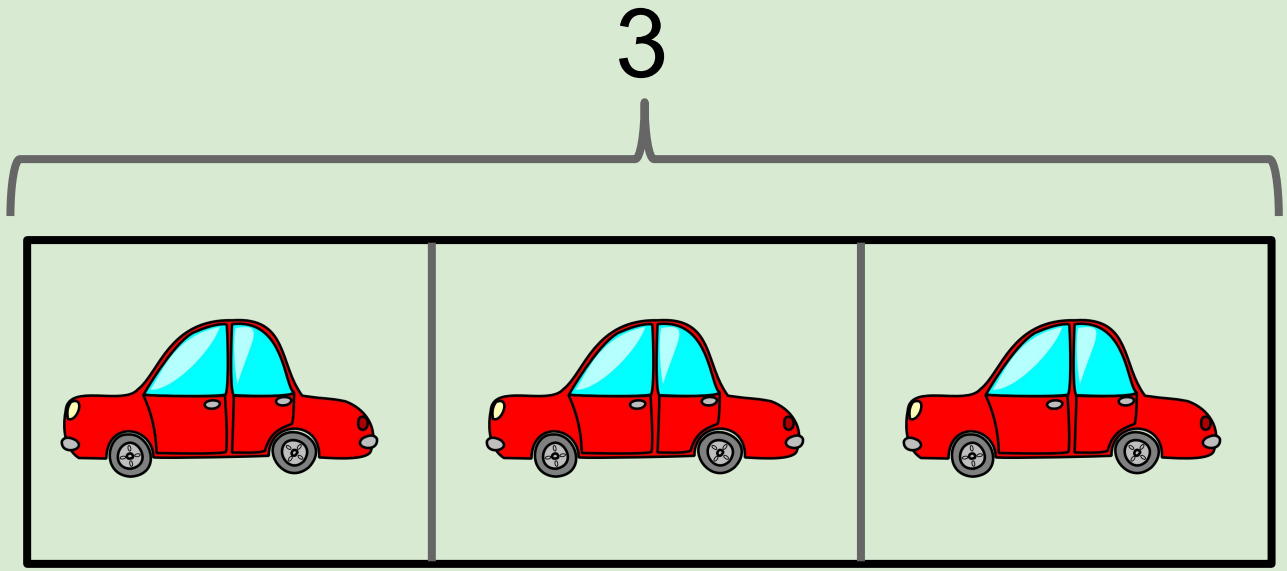


Step 3 - Drawing a bar around pictures

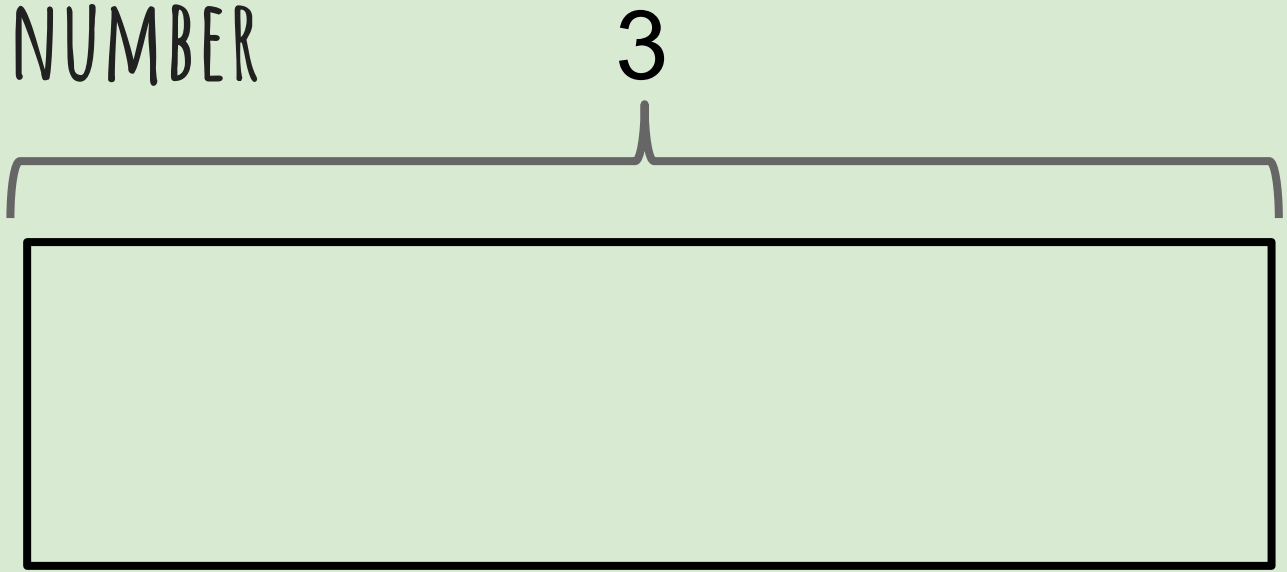
Step 3 - Drawing a bar around pictures



Step 4 - Recording the number of bars



Step 5 - Drawing a bar to represent an amount, label with a number



Step 1&2: Counting and lining the objects up

Mrs Bell has 4 pigs and 3 cows.

How many animals has she got altogether?

Mrs Bell has got _____ animals altogether.

Step 3: Drawing a bar around the pictures

Mrs Bell has 4 pigs and 3 cows.

How many animals has she got altogether?

Mrs Bell has got _____ animals altogether.

Step 4: Recording the number of bars

Mrs Bell has 4 pigs and 3 cows.

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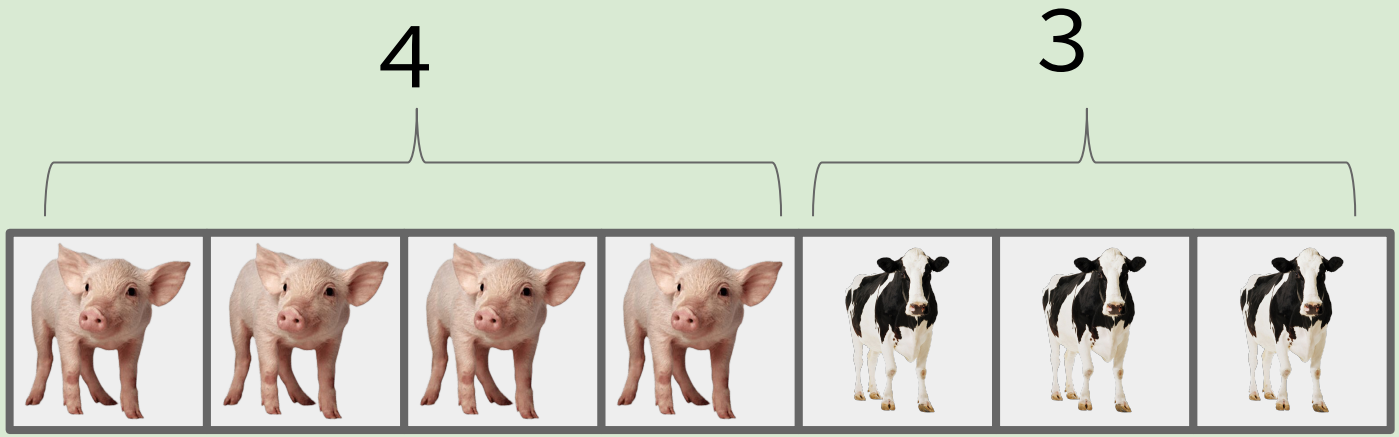

Mrs Bell has got _____ animals altogether.

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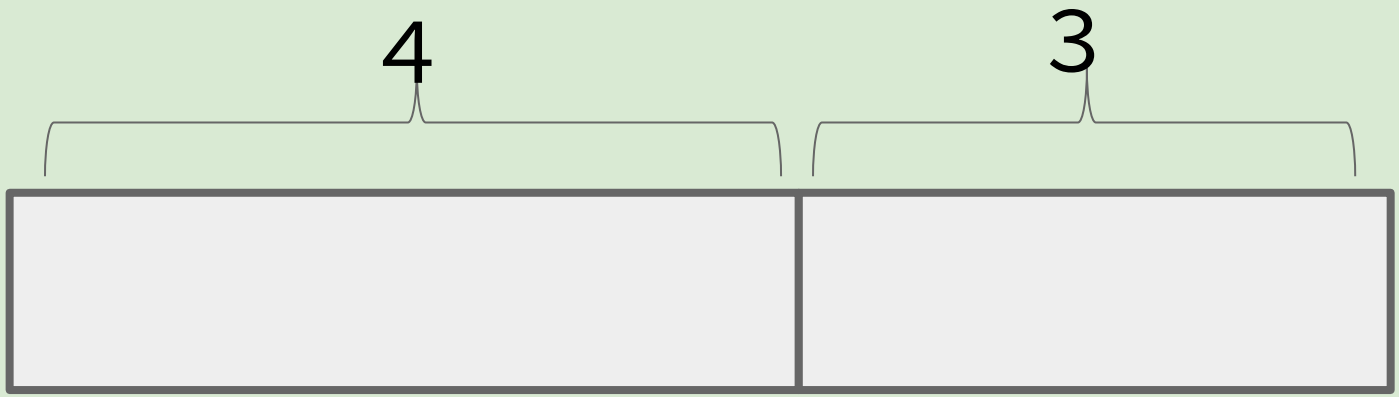


Mrs Bell has got _____ animals altogether.

Part - Whole Model

Miss Bream has 7 sweets and Mr Hodges has 5 sweets.

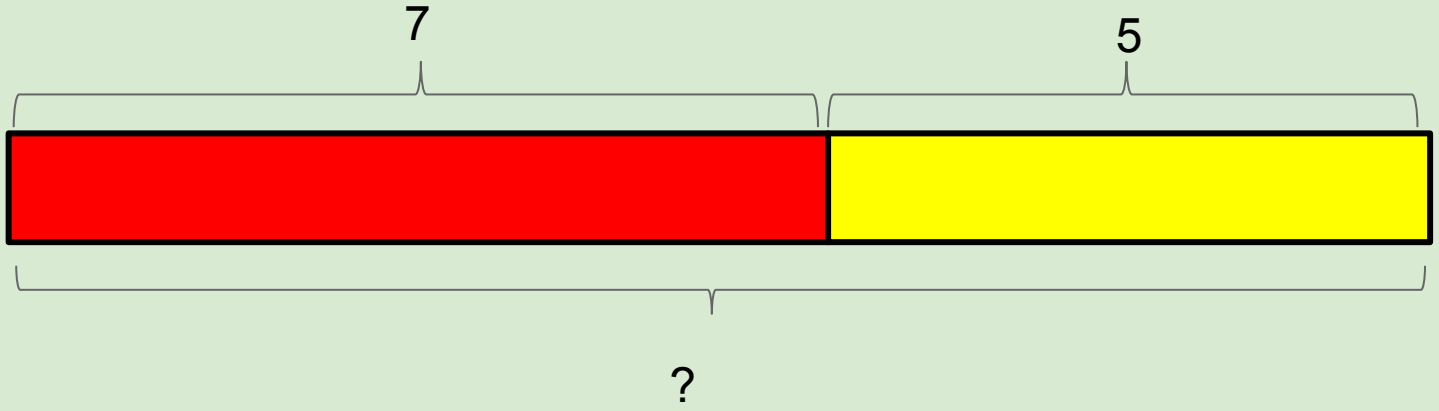
How many do they have altogether?

They have ____ sweets altogether.

Part - Whole Model

Miss Bream has 7 sweets and Mr Hodges has 5 sweets.

How many do they have altogether?



They have ____ sweets altogether.

Part - Whole Model

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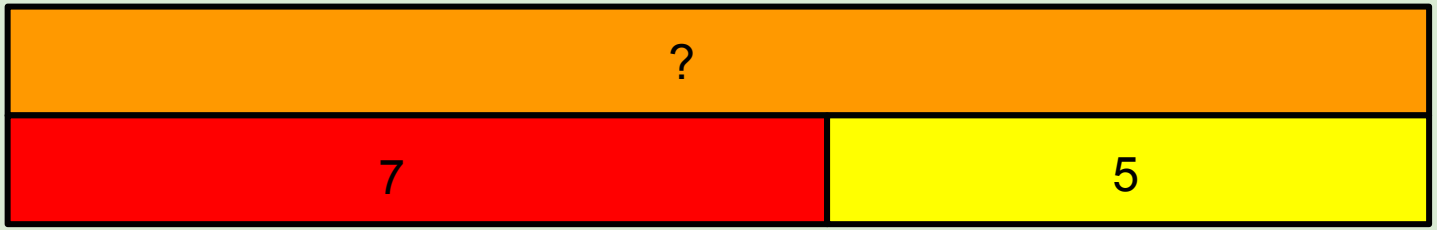
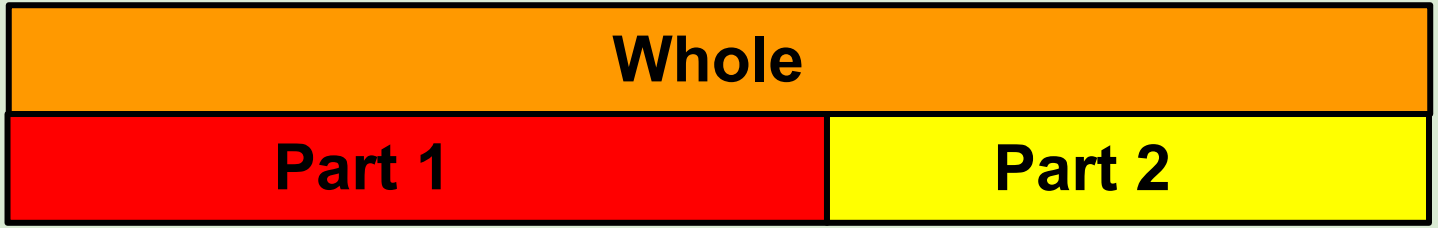


They have ____ sweets altogether.

Part - Whole model for Addition and Subtraction

The model represents a quantitative relationship between three variables.

Whole, Part 1 and Part 2



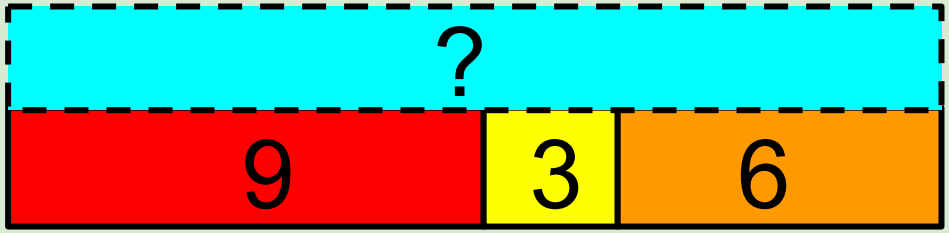
Given the values of any 2 variables, we can find the third one by addition or subtraction.

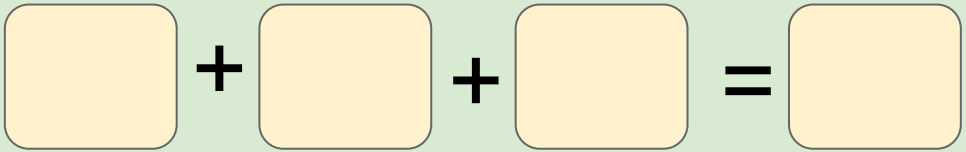
Dr Kho Tek Hong

Part- Part - Whole Model

Mrs Davies has 9 pokemon cards.
Mrs LANGAN gives her 3 cards.
Mr Greene buys her another 6 cards.

How many cards does Mrs davies Have altogether?





Mrs Davies has ____ cards altogether.

BIG MATHS CHALLENGE!

Date:_____

Score:_____

1 more than 20

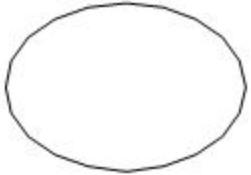
6 x 2 =	8 x 2 =
7 x 2 =	9 x 2 =

9
19
29
39
→
59
69
→
89
99

BIG MATHS CHALLENGE!

Saturday

What is 5 more than 15?



Sunday

Can you complete these number sequences?

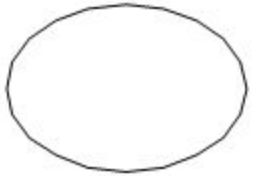
10, 9, ___, 7, ___, 5, 4, 3, ___, 1, ___

25, 26, ____, ____, 29, ____, 31, ____

38, 39, ____, 41, ____, ____, 44, 45, ____

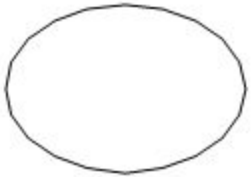
Monday

Work out 4 lots of 2...



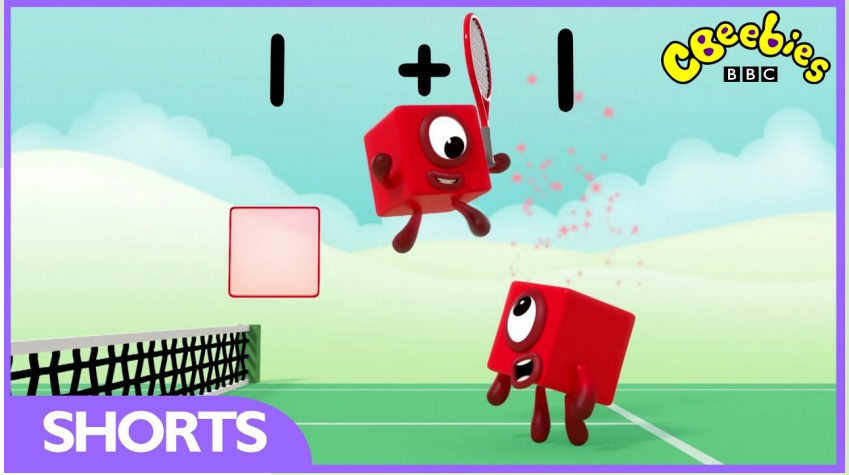
Tuesday

Share 8 into 2 groups.
How many in each group?



Wednesday

Count from 25 to 40.
Challenge mum/dad to count higher!
Can you help when they get stuck?



Number blocks